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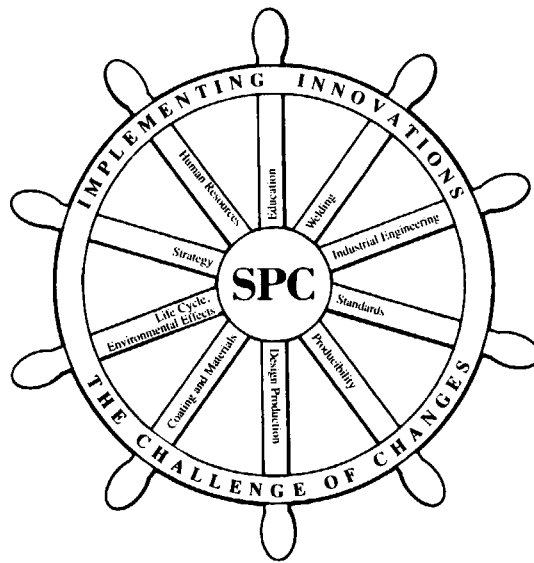
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Training Shipbuilders With the Classroom of the Future

No. 9A-1

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ABSTRACT

To achieve the quality and productivity gains necessary to compete successfully in a global market, shipbuilders must prepare employees to apply diverse principles to complex problems. Rote learning of facts is no longer a useful paradigm for training employees to accomplish a wide range of shipbuilding jobs.

Imagine a classroom where the instructor has the ability to monitor the trainee's level of comprehension and motivation, even as the presentation is underway. This same classroom provides the instructor with instantaneous control over a complete suite of advanced instructional equipment and environmental conditions. Newport News Shipbuilding has used the interactive technologies provided by such a classroom, combined with group facilitation methods to significantly improve pass rates in a trades radiological control training program from 67% to 89%. One result of this improved pass rate is that retraining requirements in this program have been reduced by 67%. This report describes the use of this Advanced Technology Classroom (ATC) to meet customer requirements to upgrade classroom performance of radiological control employees. The customer's challenge, our review of the available technology, and the characteristics of the ATC will be discussed. The effects of organizational variables, normative change in the classroom, and relevant research concerning the use Of interactive instructional technology will also be covered. Finally, the implications of the ATC for other shipyard training will be addressed.

INTRODUCTION

The shipbuilding industry faces increasingly competitive markets on a global basis. bower demand is driving the cost of products down, while business costs continue to rise at a rapid pace. Additionally, customer quality requirements are changing. Industry customers expect delivery of consistently higher quality products with no significant increase in the price of these products. In this environment, shipbuilders must use training as a resource to prevent unnecessary rework and lost time, promote flexibility in the workforce and reduce cost. Employees in a competitive work force must be able to apply knowledge gained through training to an infinite variety of work situations. To meet these expectations, without significant growth in budgets, training departments must adapt available training technology to the unique needs of the shipbuilding and repair industry.

The Shipyard has combined the power of technology with the best practices in classroom training to design, develop, implement and evaluate a 40 hour radiological control course intended to qualify or requalify over 2000 skilled employees per year. The heart of this project has been the adaptation of International Business Machines (IBM's) Advanced Technology Classroom (ATC) to the training of skilled trades personnel. The use of this "classroom of the future" combines the best of traditional training with emerging instructional technology.

Over hundreds of years, educators have developed pragmatic, psychological methods for classroom instruction. Using the ATC to integrate these classroom methods with the robust and powerful efficiencies of instructional technology, the program exemplified the best of both approaches. Proven adult classroom

methods, supported by instructional technology, have resulted in a course which minimizes memorization and rote learning and emphasizes problem-solving and decision making skills. These "thinking skills" require higher cognitive strategies. They are particularly important in job situations where employees must deal correctly with highly variable and complex situations. Since all variable situations cannot be anticipated and individually dealt with during development and presentation of training programs, rote memorization of "canned" responses is an inappropriate learning style for these job conditions.

THE CHALLENGE

In 1958 the Shipyard began building the first nuclear powered aircraft uss ENTERPRISE. This began a long and valuable relationship with the nuclear shipbuilding branch of the U.S. Navy. This customer continues to be influenced by Admiral Rickover's philosophy of continuously raising the standards of performance in all sectors of the Navy nuclear program. Like a winning football coach, the Navy continues to send the nuclear shipbuilding team back to the practice field for further improvements. This demand for continuing improvement includes contractually required training. Every year, the Navy demands improvements in nuclear-propulsion related training programs. These challenges require flexibility, adaptability and hard work.

The latest escalation in the Navy's expecfations has been especially challenging. Over the past two years a much higher level of performance has been expected of employees qualifying for radiological control work. Trainees are now expected to:

1. master course content of increased scope and range;
2. respond to test questions which require situational analyses and problem-solving rather than rote memorization; and
3. deal with radiological control situations of increased scope and complexity.

Training that covers not only facts and principles, but also their application to complex and highly variable situations is appropriate for all employees performing high-risk jobs, whether they be radiological control, fire fighters or plant protection personnel. All employees working in high-risk jobs must be prepared to respond correctly and quickly to a wide spectrum of unanticipated events.

To further complicate the challenge, the employees participating in the radiological control program have varying degrees of writing skills. This is a significant consideration since contract specifications require the confirmation of trainee learning through the use of written examinations containing scenario/case studies. The new Navy requirements are that trainees be able to analyze a radiological situation and describe the corrective actions that must be taken. Therefore, trainees must have the ability to develop written responses that clearly, logically, and accurately describe the actions and justifications they would take to correct a range of complex radiological problems.

The task was to create a course which would teach factual and procedural information about radiological control work, and also would provide the trainees with the critical thinking and problem-solving skills necessary to apply this knowledge to variable and complicated situations. At the same time, the course had to provide instruction, practice, and feedback using in the skills necessary to describe the correct response in acceptable written essay form. Along with developing these skills, the course had to impart the radiological principles used in shipbuilding trades. Think of the connectability and relationship between analytical thinking. writing skills, radiological principles and trade knowledge. Developing a program to address these issues and requirements was the challenge.

THE TECHNOLOGY

Training technology consists of more than hardware. It involves a logical, systemic approach to the analysis and solution of training problems. The Shipyard's training and development departments have adopted the Instructional Systems Development (ISD) philosophy as the paradigm for training program development. The ISD philosophy demands the systematic analysis of many variables as a prerequisite for program design, development, implementation and evaluation. This model was the foundation upon which the response

to the increased customer requirements for radiological control training was built. Cost-effectively training over 2000 persons per year in problem-solving, decision making and writing skills, as well as the principles of radiological control, required an in-depth analysis of existing teaching methods, instructors, and facilities.

Analysis indicated that the Shipyard's traditional lecture methods could not meet the challenge, and suggested the use of some form of interactive training. Interactive Video . . training, which allows **for a** great deal of participation on an individual basis, appeared at first to be the most likely candidate. IVD's capability for individual pacing and instant remedial feedback, combined with the ability to present realistic full-motion- color video simulations of radiological control situations, seemed ideal. In addition, the content of radiological control employee training is fairly stable, which is a requirement for the effective use of IVD, since revisions to IVD courses can be costly.

A search of the literature confirmed that IVD is widely accepted in education and business as a cost effective and efficient training delivery medium. Five major literature reviews (1, 2, 3, 4, 5) have been conducted on IVD's effectiveness. These studies supported our expectations for IVD's usefulness in shipyard training. McNeil and Nelson (3) state, "Many teachers, business leaders, and administrators are enthusiastically investing in interactive video instruction as a solution to spiraling training costs and limitations in instructional time and personnel."

This finding is supported in a 1990 report by the American Society for Training and Development's BED Executive Survey$_{to}$:), which states that, of 200 human resource executives in Fortune 500 companies, "eighty-one percent report using computer-based technology to train. their employees, while half employ interactive video." They go on to say that by 1992, 71% of these companies will be using IVD systems. There is strong interest and growth in IVD use the military, business and industry, evidenced by the following endorsement from the federal government, "The Office of Productivity, Technology and Innovation (OPTI)- U.S. Department of Commerce, 'hopes that - increasing numbers of U.S. firms, factories, and educational institutions will look into and take advantage of Technology Based Learning (TBL) systemfP* (7).

However, the analysis indicated that IVD training had important limitations for use in the Shipyard's training environment, i.e.:
1. the number of persons to be trained was so large that a major investment in facilities would have been necessary to allow for the timely training of all radiological control employees in an individual instruction mode;
2. the organizational constraints associated with scheduling employees off-the-job for individual instruction were significant in the current operating culture; and
3. previous limited use of IVD indicated that, even though the instruction is individualized, some form of supervision or assistance is needed in the IVD training area, negating the often claimed IVD benefit of reducing instructor costs. These were significant factors inhibiting the choice of IVD for delivering radiological control employee training.

Nevertheless, the training staff was convinced *that* interaction was needed to impart the problem-solving and decision making skills necessary to meet the Navy's challenging requirements. Most literature describes IVD application as a one workstation-per-student teaching method. Trainees can call up their personal files, establish their own learning pace, and select content and tutorial support to fit their level of competence in the topic. What was needed was a system which combined the advantages of individualized instruction with the logistical and motivational strengths of group instruction.

Social needs including affiliation, recognition and influence are powerful motivators in shaping attitudes and values in a learning environment, and effective training design should mobilize these efforts to ensure learning. Social conventions frequently inhibit direct and purposeful design to bring about changes in attitude and values *in* many public educational settings. However, in business and industrial settings this hesitancy to encourage positive attitudes toward learning and job performance is less prevalent. A technology was needed which would

support a program designed to link learning, job performance and positive work values. Using group norms to move disruptive or inappropriate behavior toward more desirable areas was desired, e.g., taking personal responsibility for one's own learning and job performance and taking maximum advantage of learning and growth opportunities offered by the company. Training staff have no influence over many aspects of the trainees' jobs. However, the training development program wanted the trainees to derive of personal growth from participation in the electronic classroom. The program was intended to be challenging as well interesting and to emphasize the trainees' involvement in a learning adventure that would help prepare them to take an active role in the accomplishment of company goals. The Shipyard's employees are technical experts and professional shipbuilders. They expect linkage between their performance in training and their expectations for challenge and growth in their jobs. The approach and linkage was not subliminal or hidden. Classrooms and settings, as well as course materials, were specifically designed to facilitate motivation and team building through increased instructor and trainee interaction. During instructor and trainee dialogues, values which support company business objectives were surfaced and reinforced. This impetus for trainees to change their outlooks and behaviors toward the collective good, i.e. company success, would be reinforced by their knowledge of business conditions affecting the shipbuilding industry.

The benefits of high levels of interaction between trainees, content and instructor became a major factor in selecting training technology. The successful implementation of training technology at the Shipyard would involve re-purposing traditional classroom instruction to the desired interactive approach. The instructor would no longer act as the technical expert, but would be a facilitator and coach, with the information-transfer role provided by the technology. Research (8, 9) indicates that computers have increased value when used as instructional support vehicles rather than exclusive methods of delivery. That is, computers function best in programs that integrate technology with live instruction, rather than as a replacement for instructors.

A fifteen year review of the use of computers in teaching conceptual and procedural skills in mathematics revealed the following.

1. Using Computer Assisted Instruction substitute for regular instruction is of questionable value, especially when compared to using it to supplement such instruction.
2. Using computers for instructional support is best achieved in the tutorial mode.
3. Using computers as a supplement to more traditional training increases the speed of learning and improves student achievement.
4. Using computers in this way seems to have the greatest impact on disadvantaged and low ability students.

These findings suggest that the integration of technology with more traditional group methods would work well with procedure-based learning requirements. This integration of technology with traditional group methods was the keystone upon which the project was built. Facilitation and group activities to support the social forces which enhance learning had to be combined with the technological hardware and courseware to support individualization of the learning process and provide instant prescriptive feedback for real time remediation.

A number of important organizational questions had to be answered prior to purchasing equipment and implementing an electronic classroom approach. First, did the Shipyard have the knowledgeable and experienced staff required to design and author a sophisticated computer-based interactive course on radiological problem-solving skills? The Shipyard training and technical staffs had worked well in the past, using a cross-functional team approach on projects of similar complexity, and it was felt they could succeed again. Although there were risks, training management and members of the project team were willing to accept them. Second, could the company get an adequate return on its investment in such training? Calculations, based on reduced time away from the job and predicted improvement in the passing rates, indicated that the potential payback was worth the risk. Success would depend on other factors beyond technical competency of the staff or the level of risk everyone was willing to take.

Organizational factors such as

skills in communication, decision-making, goal setting, conflict resolution, problem-solving and team building were also critical to success. Much effort would be needed to ensure organizational buy-in prior to critical milestones. To ensure a permanent institutional change, innovative programs such as the electronic classroom require organizational learning. The full gamut of organizational change strategies were built into the project's implementation process, including: staff role clarification. resolution of cross-functional expectations, use of new scheduling tools, agreed-to milestones, and staff and facilitator training. Decisions design strategies, presentation strategies, visual design, video program segmentation, embedded tests, graphics formats, keypad questions, final exam scenarios and grading requirements were among thousands of decisions that had to be agreed to. Since three departments would be involved in the project: (the training systems department that would develop the program, the skills training department that would deliver the training, and the radiological control department that would provide the technical experts and interpret customer requirements), attending to these organizational variables would be as much a requirement for success as was the correct selection of hardware, software, and courseware.

ADVANCED TECHNOLOGY CLASSROOM

The mission of the Shipyard's Training Systems and *Services* Department includes staying aware of current applications of training technology. In carrying out this responsibility, training program developers learned of a system which IBM was using for its own in-house management development. This "Advanced Technology Classroom[1]' (ATC) combined the presentation options of videodisc, videotape, audio cassette and VideoShow" (a graphic display system made by General Parametrics Corporation) with a high resolution rear projection screen and a student response system. All of these components were controlled by a Smart Lectern, consisting of a personal computer and a touch sensitive plasma display panel. Further investigation determined the ATC could serve as the centerpiece of our group-interactive program. The ATC transforms the traditional teaching environment into a state-of-the-art, fully integrated electronic classroom. It facilitates interactions between student and teacher with computer-based, pre-authored lesson plans supported by a variety of instructional media. *The* instructor becomes a facilitator, who orchestrates the outputs of the personal computer with graphics and text, videodisc, audiotape and linear video programs to meet the learning needs of the trainees. In the electronic classroom facility, even the environmental factors can be adjusted by the facilitator, as appropriate to the learning situation. The facilitator is able to exercise control of the media and program, either through a hand-held remote control device or from the Smart Lectern?

At a touch of the built-in plasma panel screen, the facilitator can move back and forth through the learning events making up the lesson, and show any sequence of content, including trainee responses. An electronic blackboard allows the facilitator to produce and project original illustrations and annotate existing visuals. Simultaneously, the facilitator can view prompts or cues and the sequence of upcoming content. The facilitator's personal notes can also be programmed into the system and read from the smart lectern screen.

The ATC offers employees a means to actively participate in the learning process in the classroom environment. An electronic keypad at each student's desk allows individual responses to questions programmed into the instruction at critical lesson junctures. Using data generated by these student answers, the ATC system tabulates and displays, for immediate use, all responses for comparison to others in the current class and all previous classes.

This multimedia system, when developed using learning strategies intended to teach problem-solving, confronts the issue of teacher proficiency. By training top-notch classroom instructors during the development of a program, they become facilitators in presenting the program and can be elevated to a higher level of effectiveness.

The system resolves a number of methodological issues encountered by all instructors, regardless of course content or student audience. First, the system provides a rapid paced mixture of stimuli, which is a salient feature of all effective instruction. Each time the stimulus changes, and that is often, the learner naturally refocuses his or her attention.

Increased attention from increased stimuli leads to faster learning and longer retention. Second, logistics problems encountered in coordinating the use of several media devices, such as videotape, slide projector, chalkboard, overhead projectors, computer graphics and laser discs, are no longer an excuse for non-use. In its normal mode, the ATC automatically turns these devices on and off, as needed. When the devices are being controlled by the facilitator, they are energized from a single controller, either the smart lectern or the hand-held remote control device Third, management of class time is controlled through the automation of the pre-authored- presentation. The intellectual burden on the facilitator is shifted from remembering what to say next to interpreting the meaning and importance of the content. Fourth, the facilitator/instructor's age old question, "Am I getting the message through?" is resolved through immediate electronic feedback. After each keypad question, the facilitator can see how each trainee responded using the display panel on the lectern's plasma screen. Subsequently, group response data are compiled and graphically displayed on a rear projection screen to stimulate discussion and reinforce the correct response. The keypad questions embedded in the program can include both content and attitude inquiries, so that both comprehension and motivation can be monitored. Fifth, the classroom's shape and seating arrangement are designed to increase student interaction. The students are encouraged to address comments to one another as well as to the facilitator. The facilitator reinforces this behavior, which enhances interest and motivation to the point that discussion of critical points often extend into breaks and after class. Once the students learn it is acceptable to speak up and join in, the flood gates holding back enthusiasm and participation are opened wide, releasing supportive anecdotal job examples of job situations confirming the concepts and principles presented in the lessons.

PROJECT IMPLEMENTATION

The Shipyard took delivery of its first ATC on June 1, 1990. This was essentially a prototype product which IBM had previously used for its internal management development. Their research and marketing staff worked closely with the Shipyard

instructional design staff as development and courseware production began. This collaboration led to a business partnership between the companies intended to expand and improve the capabilities of the ATC. As a result, the developer is now marketing a second generation product called the Interactive Multi-Media Classroom (IMMC). The Shipyard has obtained two IMMC systems and-is using them interchangeably with the ATC as components of the electronic classroom.

A multi-department team was formed to develop our radiological control course. The team consisted of training program developers and video production personnel from the training systems department, instructors and supervisors from the trade training department and technical experts from the radiological control department. The team's original mission was to convert a course module which dealt with handling unusual radiological control situations from a traditional training approach to an electronic classroom approach. The segment on controlling unusual hazardous situations was the course component that the Navy was most anxious to have strengthened. Developing and pilot testing this difficult segment provided both experience in developing electronic classroom strategies and confidence that the new approach would enable the Shipyard to meet everyones expectations.

By October 1990, the training department was ready to begin a series of pilot tests that continued through May, 1991. After these tests, the department was convinced that the electronic classroom should become the primary method of presenting radiological control training. In June 1991, the development team began conversion of the remainder of the radiological control course to the electronic classroom. This project was completed in September, 1991. Since that time, all initial radiological control qualification training has used the new interactive courseware. In May of 1992) conversion of the radiation requalification lecture courses to the electronic classroom format was completed. Opportunities to expand this approach to other training programs that may be suitable for conversion are being identified.

PROJECT EVALUATION

Converting radiological control training to the electronic classroom

approach was a project of such size and complexity that evaluation had to be conducted on many levels. Prior to determining whether the project met its return-on-investment objectives, the results *in* terms of increases in learning and training efficiency had to *be* measured, and such seemingly peripheral items as trainee satisfaction and staff acceptance of the new technology evaluated. Another important evaluation question was whether the introduction of new hardware processes and relationships strengthened or weakened our training organization.

The answer to the question, "Did introduction of the ATC result in increased learning and a more efficient training process?" was an unconditional Yes." The percentage of trainees who failed the course declined dramatically after introduction of the ATC. In 1991, using traditional training methods, our failure rate for first-time radiological control trainees was 33%. Since the Shipyard started using the electronic classroom, the failure rate has declined to 11%. These improvements in pass rates and average scores have been achieved while significantly increasing the scope and difficulty of the course. These *new* standards of trainee performance satisfy the Navy's need to be more comfortable with radiological *control* employees' ability to respond correctly to a wide range of radiological control situations. Navy representatives have reviewed the program and found our resolution to their challenge to be "unique" and "very positive." Although a formal analysis of the return on investment from these improvements has not been completed, these increases in learning, learner motivation, course efficiency, and customer satisfaction should more than pay for the costs of the ATC conversion.

On a more personal and subjective level, the question, "Would we do this again?" can be answered with a another resounding, "Yes." Being part of a project to invent and implement a project to success is very rewarding. It has also resulted in increased job satisfaction and promoted a spirit of camaraderie among all of us who took the risk. The training program developers and instructors agree that the project was challenging, rewarding, and has resulted in a great deal of personal growth.

The three departments participating in the project gained new skills and were strengthened internally. The group processes and shared viewpoints learned through participation on the project team will have a long lasting impact on all future interactions.

The operating departments and trainees, who are the Shipyard's internal customers, also believe that the multimedia technology incorporated into the ATC represents a more effective approach to training, especially when the objectives include the application of principles rather than mere memorization of facts and procedures. The line managers who supervise the trainees completing the program see the benefits in terms of less time off the job, less need for retraining and better trained personnel. There seems to be no question that the trainees prefer training that is interactive, fast paced, and directly related to their jobs. Evaluations conducted after each class confirm that the trainees' motivation and attention levels, general attitudes about company training and level of confidence in course content are all quite positive. Finally, on measures that are always of vital importance in the shipbuilding industry, the project was completed on schedule and within budget.

IMPLICATIONS FOR OTHER SHIPYARDS

There is an old joke that goes, "Profits are down. It must be time to cut the training budget again." cutting the training budget is not the answer to a downward spiral of profits. However, increasing training effectiveness and efficiency can be a proper response. This experience with multimedia at the Shipyard has shown that a judicious integration of innovative technology with traditional training methods provides a profitable solution to a type of training problem which will become more and more prevalent as U.S. shipyards reorganize for global competitiveness. That is, training employees to apply principles and problem-solving methodology to a wide range of work situations which cannot be anticipated when designing or presenting training programs. In addition to high-risk training, of which the radiological control program is typical, other uses might include application of quality techniques such as Statistical Process Control (SPC) to shipbuilding situations and training of test and maintenance personnel in troubleshooting. Similarly, Hartigan's paper, "Shipyard Trade Skills Testing Program" (10),

pointed the way to effective use of training technology for "just in time" training of individual employees.

However, for an industry attempting to redefine itself for global competitiveness, shipbuilding is far behind other industries in the use of educational technology. In 1991, the NSRP sponsored an investigation into the feasibility of using interactive instructional technologies in U.S. shipyards. This landmark study was managed by William E. Wilson, National Steel and Shipbuilding Company, technically supervised by Mr. John W. Hartigan, Director of Shipyard Training, Naval Sea Systems Command and performed by Richard B. Cooper of Ship Analytics, [11] - This study found that the conditions for successful use of interactive video disc technology were present in many shipyard training applications. These conditions exist when:

1. there are large numbers of students;
2. instructors with subject matter expertise are difficult to obtain;
3. simulation of equipment, procedures, or activities is required;
4. potentially hazardous procedures are to be taught;
5. the training requires continuous practice, re-training or re-qualification;
6. the content is relatively stable over time;
7. training requires problem-solving or decision making; and
8. students vary in experience or skill level.

All these criteria need not be present in order to bring about performance improvements or 'cost efficiencies. However, if several of them are present, a detailed job-task analysis followed by a cost-benefit analysis should be conducted to determine if expenditures for the introduction of- technology are justified. A lack of knowledge of interactive technologies, and in-deed, of task analysis and cost-benefit analysis skills may be one reason for the lack of more widespread use of training technology in U.S. shipyards. The NSRP Report (11) states that, "Few shipyards, private or naval, currently use interactive instruction for skilled-trade training." When asked to rate their familiarity and knowledge on this topic, 90% of the private and 86% of the naval shipyards reported they were either "mostly" or "completely unfamiliar" with the technology: This is a disturbing finding, considering that interactive technology has been in public use for almost a decade. This lack of knowledge or interest is further substantiated in a follow-up question that asked, "If assistance were offered, would you be interested in implementing this technology?" A response of "Possibly welcome or Not be interested" was given by 84% of the private and 57% of the naval shipyards.

There are many reasons for this lack of knowledge, experience, and interest, foremost of which may be the shipbuilding industry's generally conservative and traditional approach to innovation. However, the end result under utilization of technology in areas where it could cut costs and improve the effectiveness of shipyard training.

Insight into the organizational effects of unbridled trust in tradition is provided in a paper presented by Rogness, "Breaking the Chains of Tradition and Fantasy - A Revolutionary Approach to - the Constraints on Productivity" [12] - Rogness states most eloquently and forcefully of the lack of change in American shipyards: "It is very difficult to overcome the inertia and incumbency of tradition in an environment where it is not realized that all facets of a tradition are nothing but precipitates of earlier changes. It is extremely difficult for a creative thinker to survive in a repressive environment which ENFORCES unquestioning acceptance of tradition, rather than ALLOWING the vigorous pursuit of new knowledge." The personal risks to bring about change in an authoritarian system are often so high that the final outcome is institutional atrophy.

To be an effective instrument of change in the movement to streamline the ship production process, training must accomplish the following.

1. Employees must learn the principles behind shipbuilding processes and techniques.
2. Training must teach employees how to apply these principles to manufacturing shops and shipboard production environments. Training developers and instructors can never anticipate the problems and decisions employees will encounter on the job. Therefore, the application of principles, and not rote

memorization of "canned" solutions, must be the intent of training.

3. Labor costs and time away from the job required for training must be minimized.

4. Offer training programs that are like laser beams targeted to specific employees just prior to a specific job.

As indicated by the Wilson, Hartigan, and Cooper study (11), Hartigan's just-in-time training scenario, and our experience with the electronic classroom, the judicious and imaginative use of available training technology provides an avenue for reaching these goals. Conservatism and reliance on tradition must not blind the shipbuilding management to the advantages to be gained. Effective and efficient training of the workforce in U.S. shipyards must be an issue for everyone in the industry. Global competition demands continual improvement in product quality and labor productivity. U.S. shipyards' manhour productivity per unit of output is reported as being only 40% that of Japan and 82% of Korean shipyards. Certainly, a contributing factor to this state of affairs is the "comparatively low level of education and training of employees, staff, and management"-(13). The implications of this productivity gap for the shipbuiiding industry's survival are too significant to leave to the evolution of traditional training methods, geared to the comfort level of training departments. As is true *for* all revolutions, change rarely comes from within, it must be imposed by those with visions and intestinal fortitude. Operating management must articulate the strategic targets for improved job performance which training can meet through the application of technology. Operating management must then provide the necessary resources and demand accountability from training departments for improved trainee performance on the job.

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